DOCUMENT RESUME

ED 187 864 CE 025 100

TITLE Project EFFECT. Energy for the Future: Education, Conservation, Training. Curriculum Guide for the Training of Energy Extension Agents. A Working Paper, Section 1: General Background.

INSTITUTION Indiana Univ., South Bend. Center for Energy Conservation.

SPONS AGENCY Office of Education (DHEW), Washington, D.C.

PUB DATE 79

NOTE 80p.; For related documents see CE 025 099-103 and CE 025 105.

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.

DESCRIPTORS Adult Education; *Algebra; Behavioral Objectives; Conservation Education; Core Curriculum; Course Descriptions; Curriculum Guides; Diagnostic Teaching; Energy; *Energy Conservation; *Extension Agents; Group Dynamics; Instructional Materials; Job Skills; Learning Activities; Orientation Materials; Paraprofessional Personnel; Postsecondary Education; *Power Technology; Pretests Posttests; *Review (Reexamination); Tests; Vocabulary; Vocational Education; *Writing Instruction

IDENTIFIERS Energy Extension Agents

ABSTRACT

This first of four sections in a curriculum guide for training energy extension agents contains general introductory materials, an overview of the total curriculum, and four modules: Orientation, Mathematics Review, Basic Writing, and Energy Overview. The curriculum is designed for adults with at least eighth grade reading and math skills but without previous technical training. Following a brief description of the project which developed the curriculum (Project EFFECT--Energy for the Future: Education, Conservation, Training), these supplementary materials are provided: energy extension agent competencies, core curriculum outline, and class calendar for the eight-month program. The modules in this section serve a dual purpose--diagnostic and introductory. A systematic review using these materials is based on student performance on provided writing and mathematics pretests. The fourth module itself introduces students to the technical, socio-political, and economic aspects of the energy situation and provides them with pertinent vocabulary. Contents of each module include objectives; teaching/learning activities, resources, and evaluation (quizzes and examinations) keyed to the objectives; and syllabi containing descriptions of content on a class-by-class basis. Also available in ERIC are a volume containing sample worksheets, handouts, and examinations for each module as well as full references to all outside sources needed; other sections of the guide; and a final report of the project--see Note. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

CE 025 100

ED187864

PROJECT EFFECT

Energy For The Future: Education, Conservation, Training

CURRICULUM GUIDE

for the training of

ENERGY EXTENSION AGENTS

A WORKING PAPER

Section 1

October 1979

GENERAL BACKGROUND

Project Staff

James H. Ryan, Ph.D., Project Director
Director, Division of Continuing Education
Neil V. Weber, Ph.D., Academic Coordinator
Gail S. Dowty, Project Administrator
Robert F. Werner, Jr., Technical Coordinator
James D. Regelean, Curriculum Development Associate
Paul C. Boyer, Audit Materials Specialist
Sheryl A. Million, Project Secretary
M. Joyce Ashman, Secretary
Samuel R. Wiersteiner, Ph.D., Special Advisor
Director, Division of General and Technical Studies

Indiana University at South Bend: Division of Arts and Sciences
Division of Continuing Education
Division of General and Technical Studies

Funded by the Department of Health, Education & Welfare, U.S. Office of Education
Community Service and Continuing Education Branch,
Grant #G77-2645 under Title I, Special Projects

PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Indiana University
J.D. Mulholland
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM.

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

PROJECT EFFECT

Curriculum Guide for Training

ENERGY EXTENSION AGENTS

TABLE OF CONTENTS

	Page
Introduction	3
Organization of Curriculum Guide	6
Supplementary Materials	7
Energy Extension Agent Competencies	8
Project Time Line	9
Core Curriculum	10
Class Calendar	14

Curriculum Guide - See next page for contents

Copyright for these materials is claimed only during the period of development, test, and evaluation, unless authorization is granted by the U.S. Office of Education to claim copyright also on the final materials. For information on the status of the copyright claim, contact either the copyright proprietor or the U.S. Office of Education.

PROJECT EFFECT

Curriculum Guide For Training

ENERGY EXTENSION AGENTS

TABLE OF CONTENTS - CURRICULUM GUIDE

	Page
Section I - General Background	
Orientation	1-3
Mathematics Review	1-6
Basic Writing	1-12
Energy Overview	1-15
Section II - Technical Training	2-1
Alternative Energy Sources (Solar and Wood)	2-3
Basic Graphics and Blueprint Reading	2-13
Building Materials	2-21
Electricity	2-29
Introduction to Cooling Systems	2-41
Introduction to Heating Systems	2-48
Insulation and Ventilation	2-57
Lighting Efficiency	2-62
Section III - Energy Audit Preparation	3-1
Energy Cost Calculations	3-3
Energy Use Survey	3-9
Field Observations (Practicum)	3-34
Energy Use Survey (Practicum)	3-38
Section IV - Community Education Component	4-1
Regional Demography	4-3
State and Local Government	4-39
Community Education	4-44
Neighborhood Workshops (Practicum)	4-50
Miscellaneous Activities (Practicum)	4-53

PROJECT EFFECT

CURRICULUM GUIDE

INTRODUCTION

Objectives and Activities

The most critical problem facing mankind in the near future is making the best use of our precious energy resources. The problem is first to change the attitudes of people about energy use. Particularly in the United States, the idea of unlimited, inexpensive energy for all must give way to conservative, thoughtful use of limited energy resources. Once people become aware of the need for immediate action to prevent drastic hardship in the future, they require reliable and unbiased information upon which to act. As resources dwindle and technology advances, the public must be kept informed of new developments so that they can continue to use energy effectively.

In its effort to address the need for technically trained manpower and informed citizens, Project EFFECT developed objectives in the three basic areas of Curriculum Development, Training, and Community Education, as follows:

1. To create a comprehensive training program for adults without previous technical training, applicable to community energy conservation needs, and usable in other communities in a variety of regions.

2. To define the new occupational role of Energy Extension Agent and to provide training for this agent, who would become a new community resource.

3. To heighten community awareness of energy conservation.

To meet these objectives, the project engages in the following major activities:

1. Production of a package of training materials on energy utilization and management, tested both with trainees and the community participants;

2. Selection and training of a team of Energy Extension Agents;

3. Placing the Energy Extension Agents in local agencies and organizations and businesses as energy utilization technicians;

4. Application of energy conservation techniques in the community through residential audits and community, neighborhood and agency workshops;

5. Establishment of a community resource file of people and agencies;

6. Promotion of community education about energy utilization through local, regional and national media emphasis;

7. Delivery of materials and workshops outside of the immediate project region.

Two additional major components in the area of technical assistance and curriculum evaluation and dissemination are:

1. Short term workshops, seminars, and institutes are conducted for technical personnel, utilities, public and governmental agencies, and include continuing education for Project graduates;

2. Regional and national conferences are conducted to evaluate the training program and to share curriculum development activities with others in the field.

An advisory committee made up of professionals from local business, industrial, educational and governmental institutions give valuable guidance in shaping the curriculum and in recruiting teaching staff from outside the university. In particular, much of the practical instruction in heating and cooling, insulation, and building codes is conducted with the help of community professionals in these fields.

The Project is funded by the U.S. Office of Education, Community Service and Continuing Education Branch, under a Title I grant.

Progress and Accomplishments

Since project start-up in October 1977, an eight-month curriculum has been developed and field-tested with two groups of trainees. The July 1978 class was entirely supported by three local CETA agencies (South Bend, St. Joseph County, and Elkhart County) and sixteen students were graduated. The 1979 class included some students funded by CETA (South Bend and St. Joseph County) but most class members were self-supporting. Ten were graduated in July 1979. Graduates are employed with governmental agencies, community action agencies, construction firms, architectural contracting firms and insulation contractors. Other placement opportunities are being developed in city-government, state energy offices, local industry and educational systems, and utilities.

In addition, Project EFFECT staff has conducted pilot two-day workshops for the South Bend Community School Corporation's physical plant superintendents and staff and for Indiana and Michigan Electric Company field representatives.

Additional activities include an energy curriculum evaluation workshop held in 1978. A small task force representing Federal offices, curriculum development and training programs and energy conservation experts was invited to conduct an intensive critique of the EFFECT curriculum. Second year revisions in the training program were based on their suggestions as well as on the lessons learned from the first training session.

Finally Project Staff is developing a series of workshops for the Indiana State Energy Group in five sites throughout Indiana. The workshops will enable local education agencies and hospitals to conduct energy audits of their facilities in order to qualify for Federal aid to institute energy-conserving changes.

ORGANIZATION OF CURRICULUM GUIDE

The curriculum materials are organized into four main sections and color coded as follows:

Section I - General Background (gold)
Section II - Technical Training (green)
Section III - Energy Audit Preparation (buff)
Section IV - Community Education (blue)

Each section contains general introductory materials and an overview of the total curriculum. Within each module are included objectives, resources and references, a class syllabus keying each session to the objectives, and evaluation materials such as final exams or descriptions of other evaluation strategies.

SUPPLEMENTARY MATERIALS

COMPETENCIES OF THE ENERGY EXTENSION AGENT

The Project EFFECT curriculum is designed to develop the technical and communication skills necessary to conduct an energy use survey and to explain the results of the survey to the general public. Upon completion of this eight month program, the Project EFFECT graduate can:

Conduct an energy use survey of a residential or light commercial structure, which includes:

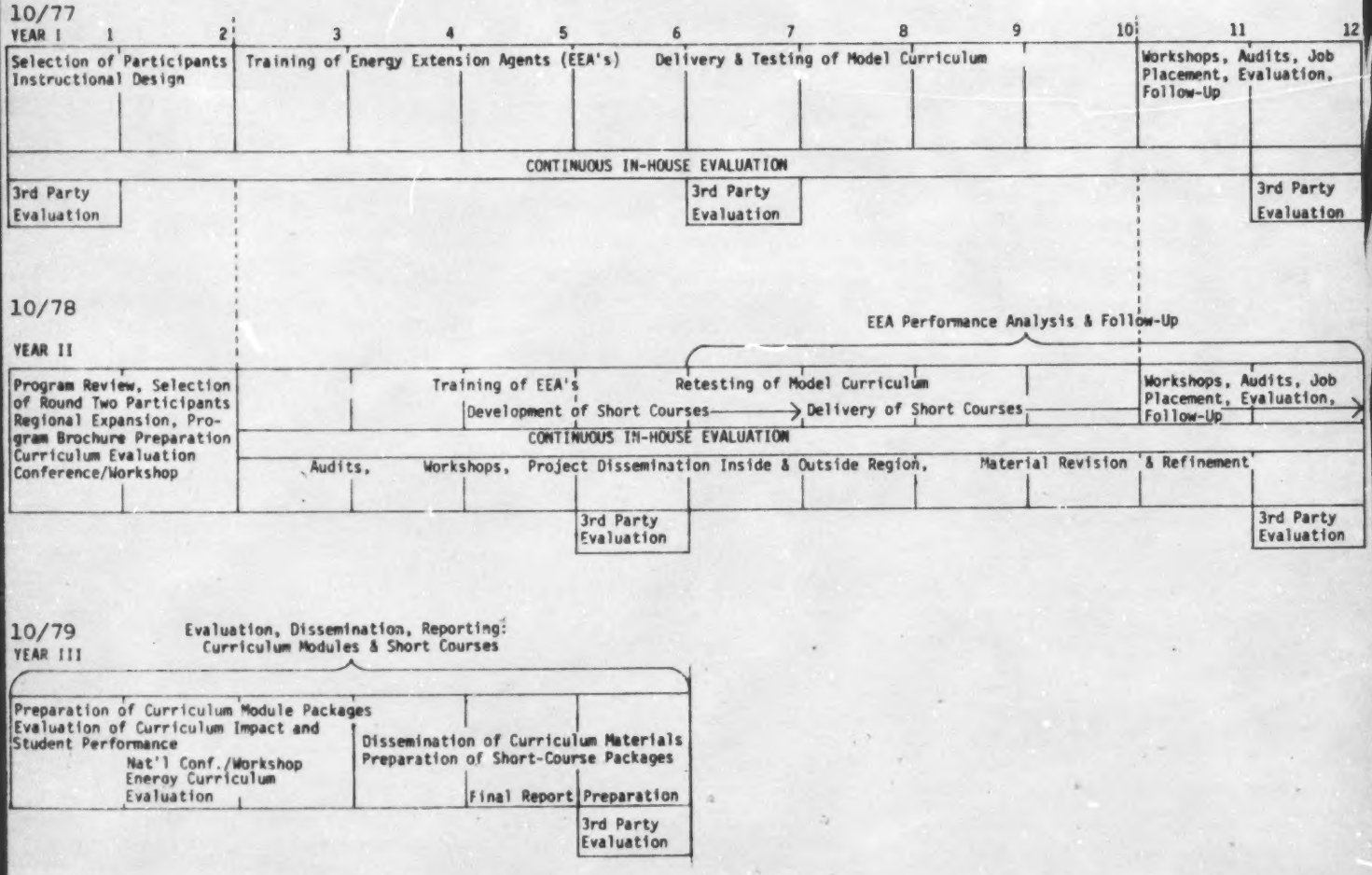
- ....a simple sketch of the structure, including plan and elevation views, showing all relevant details;
- ....an exact accounting of heat losses and heat gains due to infiltration and conduction through floors, ceilings, windows and walls;
- ....an analysis of existing insulation and ventilation and recommendations regarding the need for more or less of each;
- ....a full description of heating, cooling, hot water, lighting and appliance systems;
- ....a two year billing audit which considers fuel consumption and cost for space heating and cooling, domestic hot water, electrical equipment and other appliance systems;
- ....consultation with homeowner to recommend possible energy conservation opportunities, in order of priority, and the payback period on these investments.

Conduct an energy conservation workshop for community, professional and lay organizations, which includes:

- ....information on energy conservation methods (a breakdown of energy uses in the home, from largest to smallest, in terms of energy consumption and suggestions on how to cut down on usage);
- ....displays of different types of insulation with R-values on each and recommended usage according to specific need;
- ....displays of various types of weatherstripping and caulking and recommended usage of each;
- ....charts showing R-values on various materials and water usage in a typical home;
- ....general information on alternate energy sources;
- ....general discussions on energy related questions generated from the audience as a result of information presented.

PROJECT EFFECT

TIME LINE



PROJECT EFFECT

CORE CURRICULUM

DIDACTIC INSTRUCTION (6 MONTHS)

SECTION 1 - General Background

Module		Hours
Mathematics Review		17
Basic Writing		9.5
Energy Overview		68.5
	Total	95

SECTION 2 - Technical Training

Module		Hours
Basic Graphics and Blueprint Reading		89
Building Materials		20.5
Electricity		14
Alternative Energy Sources (Solar and Wood)		24.5
Introduction to Cooling Systems		23
Introduction to Heating Systems		37
Insulation and Ventilation		18
Lighting Efficiency		20
	Total	246

SECTION 3 - Energy Audit Preparation

Module		Hours
Energy Cost Calculations		16.5
Energy Use Survey: Procedure and Techniques		46
	Total	62.5

SECTION 4 - Community Education

Module		Hours
How to Conduct Community Energy Education Projects; Small Group Dynamics; Use of media, etc.		97
Demography and Survey Skills		38
The Organization of State and Local Government		14
	Total	149

PROJECT EFFECT

CORE CURRICULUM

PRACTICUM (2 MONTHS)

	Hours
SECTION I - Field Observations	24
SECTION II - Community Education (Workshops)	12
SECTION III - Energy Use Surveys	111
SECTION IV - Miscellaneous Activities Independent Worktime Placement and Critique Testing and Graduation	49
Total	196
+ 6 month didactic	552.5
Complete Training Program =	748.5

PROJECT EFFECT

MONTHLY HOURS OF PROGRAM CONTENT (1978 - 79)

DIDACTIC PHASE

MODULE	DEC	JAN	FEB	MAR	APR	MAY	TOTAL HOURS
AREA I - GENERAL BACKGROUND							
Mathematics Review	3	8	6				17
Basic Writing	3	5.5	1				9.5
Energy Overview	11	35.5	12.5	9.5			68.5
AREA II - TECHNICAL TRAINING							
Graphics and Blueprint Reading	9	34	24	22			89
Building Materials		6	13.5	1			20.5
Electricity			9	5			14
Alternative Energy Sources (Solar and Wood)			24.5				24.5
Introduction to Cooling Systems						23	23
Introduction to Heating Systems					37		37
Insulation and Ventilation				9	9		18
Lighting Efficiency				2.5	17.5		20
AREA III - ENERGY AUDIT PREP.							
Energy Cost Calculations					8.5	8	16.5
Energy Survey						46	46
AREA IV - COMMUNITY EDUCATION							
Community Education	46.5	8	4.5	5	15	18	97
Demography and Survey Skills		10.5	13.5	14			38
State and Local Government				4	10		14
TOTALS	72.5	107.5	108.5	72	97	95	552.5

PROJECT EFFECT

PRACTICUM HOURS PER WEEK (JUNE - JULY, 1979)

	1	2	3	4	5	6	7	8	Module totals
FIELD OBSERVATIONS	15	3	3						21
COMMUNITY EDUCATION (WORKSHOPS)		3	9						12
ENERGY USE SURVEYS	6	15	6	24	18	24	24	18	135
MISCELLANEOUS: INDEPENDENT WORKTIME	6	6	6	3	3	3			27
PLACEMENT ACTIVITIES	4		4	3		3	3		17
TESTING AND GRADUATION							1	12	13
TOTAL CLASS HOURS	31	30	28	30	21	30	28	18	225

[redacted] DECEMBER [redacted] THROUGH JANUARY 5

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 1	11 ORIENTATION 9-10 Intro and greetings - staff 10-12 Group Intro (Mosel) 12-1 Lunch 1-2:30 Logistics 2:30-4 Reception	12 9-12 Report Writing 11-12 Library Tour 1-2 Energy Pre-Test 2-4 Team Building (Mosel)	13 9-10:30 Algebra Review 10:30-12 Energy Overview 1-3:30 Energy Overview (Term Search)	14 9-12 Study Skills 1-4 Time Management Skills (Mosel)	15 9-11 Energy Overview 11-12 Community Education 1-3 Evaluation
WEEK # 2	18 9-12 Basic Graphics and Blueprints 1-2:30 Report Writing 2:30-4 Worktime	19 9-12 TABE TESTING at Goodwill Indust. 1-4 Energy Overview (Slide show)	20 9-12 Basic Graphics and Blueprints 1-2:30 Algebra 2:30-4 Worktime	21 9-10:30 Study Skills 10:30-12 Report Writing 1-3:00 Energy Overview	22 9-11 Basic Graphics and Blueprints 11-12 Comm. Ed. 1-3 Evaluation
WEEK # 3	25 CHRISTMAS	26 BREAK	27 ALL	28 WEEK	29 !!!
WEEK # 4	1 NEW YEARS DAY	2 9-10:30 Algebra Review 10:30-12 Report Writing 1-4 Energy Overview	3 9-11 Basic Graphics and Blueprints 11-12 Algebra 1-3 Energy Overview 3-4 Worktime	4 DAT TESTING ALL DAY	5 9-11 Basic Graphics and Blueprints 11-12:30 Demography 1:30-3:30 Evaluation

[redacted] JA[redacted]RY [redacted]ROU[redacted]EBR[redacted] 2

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 5	8 9-11 Basic Graphics 11-12:30 Bldg. Mats. 1:30-3 Energy Overview 3-4 Worktime	9 9-12 Energy Overview (Twin Branch field trip) 1-2:00 Algebra 2:00-4 Comm. Ed.	10 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	11 9-12 Building Mats. 1-4 Demography	12 9--1 Basic Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 6	15 9-11 Basic Graphics Class dismissed after graphics	16 9-12 Energy Overview 1-2:30 Algebra 2:30-4 Comm. Ed.	17 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	18 9-4 Energy Overview (Field trip to Cook Nuclear Plant)	19 9-11 Basic Graphics 11-12:30 Comm. Ed. 1:30-3:30 Evaluation
WEEK # 7	22 9-11 Basic Graphics 11-12:30 Worktime 1:30-3 Energy Overview 3-4 Worktime	23 9-12 Energy Overview 1-2:30 Algebra 2:30-4 Comm. Ed.	24 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	25 9-4 Energy Overview 1-4 Demography	26 9-11 Basic Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 8	29 9-11 Basic Graphics 11-12:30 Bldg. Mats. 1:30-3 Energy Over view 3-4 Worktime	30 9-12 Energy Overview 1-2:30 Algebra 2:30-4 Comm. Ed.	31 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	1 9-4 Building Materials (Slide Show Presentation)	2 9-11 Basic Graphics 11-12:30 Demography 1:30-3:30 Evaluation

22

23

FEBRUARY 5 THROUGH MARCH 2

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #9	5 9-11 Graphics 11-12:30 Bldg. Mats. 1:30-3:00 Energy Overview 3-4 Worktime	6 9-12 Energy Overview 11-12:00 Report Writing 1-2:30 Algebra 2:30-4 Comm. Ed.	7 9-11:00 Graphics 11-12 Electricity 1-3 Energy Overview (Solar)	8 9-12 Bldg. Mats. FIELD TRIP 1-4 Demography	9 9-11 Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 10	12 9-11 Graphics 11-12:30 Electricity 1:30-3 Energy Overview (solar) 3-4 Worktime	13 9-12 Energy Overview (solar) 1-2:30 Algebra 2:30-4 Comm. Ed.	14 9-11 Graphics 11-12:30 Electricity 1-3 Energy Overview (solar) 3-4 Worktime	15 SOLAR FIELD DAY (Rock Solar Home)	16 9-11 Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 11	19 9-11 Graphics 11-12:30 Electricity 1:30-3 Energy Overview (Solar) 3-4 Worktime	20 9-12 Energy Overview (solar) 1-2:30 Algebra 2:30-4 Demography	21 9-11 Graphics 11-12 Electricity 1-3 Energy Overview (Solar) 3-4 Worktime	22 9-12 Bldg. Mats. (Exam) 1-4 Demography	23 9-11 Graphics 11-12:30 Demography 1:30-3:30 Personal Interviews - Career Planning
WEEK # 12	26 9-11 Graphics 11-12:30 Electricity 1:30-3 (Wood) 3-4 Worktime	27 9-12 Energy Over view (Solar quiz) 1-2:30 Algebra (Exam) 2:30-4 Comm. Ed.	28 9-11 Graphics 11-12 Electricity 1-3 Energy Overview 3-4 Worktime	1 FIELD DAY (Bailly Power Plant)	2 9-11 Graphics 11-12:30 Demography 1:30-3:30 Evaluation

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 13	5 **********	6 **********S P	7 R I N G B R E A K	8 **********	9 **********
WEEK # 14	12 9-11 Graphics 11-12:30 Electricity 1:30-3 Energy Overview	13 9-12 Energy Overview 1-2 Comm. Ed. 2-4 Demography	14 9-11 Graphics 11-12 Electricity 1-3 Energy Overview (Hard-Soft Debate)	15 FIELD DAY GRAPHICS	16 9-12 Graphics SOUTH BEND ENERGY DAYS (SCOTTSDALE MALL)
WEEK # 15	19 9-11 Graphics 11-13:30 Electricity 1:30-3 Demography	20 8-11 Insulation 12-2 Energy Overview (final test) 2-4 Comm. Ed.	21 9-11 Graphics 11-12 Electricity (Exam) 1-3 State & Local Government	22 9-12 Insulation 1-4 Demography	23 9-12 Graphics 1-2 Job Readiness 2-3 Evaluation
WEEK # 16	26 9-11 Graphics 11-12:30 Lighting Demography cancelled	27 9-12 Insulation 1-2 Energy Overview 2-4 Comm. Ed.	28 9-11 Graphics 11-12 Lighting 1-3 State & Local Government	29 FIELD DAY (GRAPHICS)	30 9-12 Graphics 1-3 Evaluation

APRIL 2 THROUGH APRIL 27

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #17	2 9-11 Heating 11-12:30 Lighting 1:30-3 Cost Calculations	3 9-12 Insulation (Field trip) 1-4 Insulation	4 9-11 Heating 11-12 Lighting 1-4 Communications Skills (Mosel)	5 9-12 Insulation (Exam) 1-3 State & Local Government	6 9-12 Heating 1-3:00 Resume Writing
WEEK #18	7 9-11 Heating 11-12:30 Lighting 1:30-3 Cost Calculations	8 9-12 Heating 1:30-4 State & Local Government (Public Safety Hearing)	9 9-11 Heating 11-12 Lighting	10 HEATING FIELD DAY	11 9-12 Heating GOOD FRIDAY AFT. FREE
WEEK #19	16 9-10 Worktime 10:30-12 Lighting 1-3 Cost Calculations	17 9-12 Heating 1-4 Communication Skills (Mosel)	18 9-11 Heating 11-12 Lighting 1-3 State & Local Government	19 LIGHTING ANALYSIS SURVEY	20 9-12 Heating 1-3 Resume Writing
WEEK #20	23 9-11 Heating 11-12:30 Lighting 1:30-3 Cost Calculations	24 9-12 Building Codes 1-4 Comm. Ed.	25 9-11 Heating 11-12 Lighting 1-3 State & Local Government	26 HEATING FIELD DAY	27 9-12 Heating 1-3 Evaluation

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #21	30 9-11 Heating 11-12:30 Lighting (Test) 1-3 Cost Calculations	1 9-12 Building Codes 1-4 Comm. Ed.	2 9-12 Heating 1-3 Energy Surveys	3 9-12 Cost Calculations 1-4 Comm. Ed.	4 9-12 Heating 1-3 Evaluation
WEEK #22	7 9-12 Heating (exam) 1-3 Cost Calculations	8 9-12 Bldg. Codes 1-4 Comm. Ed.	9 9-12 Cooling 1-3 Energy Surveys	10 9-12 Cost Calculations 1-4 Comm. Ed.	11 9-12 Cooling TO BE ANNOUNCED
WEEK #23	14 9-12 Cooling 1-3 Energy Surveys	15 9-12 Energy Survey 1-4 Comm. Ed.	16 9-12 Cooling 1-3 Energy Surveys	17 9-12 Energy Surveys 1-4 Comm. Ed.	18 9-12 Cooling 1-3 Evaluation
WEEK #24	21 9-12 Energy Surveys 1-3 Cooling (exam)	22 ENERGY SURVEYS	23 ENERGY SURVEYS	24 ENERGY SURVEYS	25 NO CLASSES

MAY 31 THROUGH JUNE 22

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 25	28 MEMORIAL DAY	29 ENERGY USE SURVEY 1-4	30 9-4 COOLING	31 WRAP-UP	1 ORIENTATION TO PRACTICUM
WEEK # 26	4 TEAM A - SUPERVISED AUDIT TEAM B - OBSERVATIONS	5 TEAM A - OBSERVATIONS TEAM B - SUPERVISED AUDIT	6 TEAM A - WORKTIME TEAM B - OBSERVATIONS	7 TEAM A - OBSERVATIONS TEAM B - WORKTIME	8 NORTHERN INDIANA PUBLIC SERVICE CO. (GAS) WORKSHOP (ALL) BROWN BAG LUNCH JOB READINESS
WEEK #27	11 TEAM A - COMPUTER INSTRUCTION TEAM B - SUPERVISED AUDIT	12 TEAM A - SUPERVISED AUDIT TEAM B - COMPUTER INSTRUCTION	13 TEAM A COMPUTER INSTRUCTION TEAM B - WORKTIME	14 TEAM A - WORKTIME TEAM B - COMPUTER INSTRUCTION P.M. - DEMO AND PRACTIVE DELIVERING AUDIT TO CLIENT	15 INDIANA & MICHIGAN WORKSHOP (ELECTRIC CO.) DRESS REHERSAL - ENERGY CONSERVATION WORKSHOPS
WEEK #28	18 SEMI-SUPERVISED AUDITS (in teams)	19 OPTIONAL OBSERVATION - TEAMS A & B WORKTIME	20 WORKTIME DRESS REHERSAL - ENERGY CONSERVATION WORKSHOPS	21 TEAM A - WORKSHOP AT "ACTION, INC" TEAM B - WORKSHOP AT "ACTION, INC." (evening)	22 CATCH-UP BROWN BAG LUNCH JOB READINESS

JUNE 25 THROUGH JULY 20

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #29	25 START - ASSESSMENT OF AUDIT PERFORMANCE SEMI-SUPERVISED AUDITS	26 SEMI-SUPERVISED AUDITS	27 SEMI-SUPERVISED AUDITS	28 SEMI-SUPERVISED AUDITS	29 WORKTIME JOB READINESS
WEEK #30	2 INDEPENDENT AUDIT ASSESSMENT	3 INDEPENDENT AUDIT ASSESSMENT	4 INDEPENDENCE DAY NO CLASSES	5 INDEPENDENT AUDITS	6 WORKTIME JOB READINESS
WEEK #31	9 INDEPENDENT AUDITS	10 INDEPENDENT AUDITS	11 INDEPENDENT AUDITS	12 INDEPENDENT AUDITS	13 WORKTIME JOB READINESS
WEEK #32	16 INDEPENDENT AUDITS	17 INDEPENDENT AUDITS	18 INDEPENDENT AUDITS	19 INDEPENDENT AUDITS	20 ENERGY POST-TEST JOB READINESS

JULY

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 33	23 INDEPENDENT AUDITS	24 INDEPENDENT AUDITS	25 INDEPENDENT AUDITS	26 DIFFERENTIAL APTITUDE TEST (DAT'S) ALL DAY	27 GRADUATION!!!
WEEK #					
WEEK #					
WEEK #					

SECTION 1 - BACKGROUND

TABLE OF CONTENTS

	Page
Introduction	3
Organization of Curriculum Guide	6
Supplementary Materials	7
Energy Extension Agents Competencies	8
Project Time Line	9
Core Curriculum	10
Class Calendar	14
Contents - Section 1	
Orientation	1-3
Mathematics Review	1-6
Basic Writing	1-12
Energy Overview	1-15

INTRODUCTION - SECTION I

General Background

MODULES:

Orientation

Mathematics Review

Basic Writing

Energy Overview

These modules serve a dual purpose: diagnostic and introductory. The students are pre-tested in their abilities to use the basic tools of learning -- writing and mathematics. They then undertake systematic review in these areas based on pre-test performance. The pre-test in the Energy Overview covers the gamut of topics to be covered in the course. The module itself introduces students to the technical, socio-political, and economic aspects of the energy situation in the United States and provides them with a vocabulary that will enable them to discuss these concepts and issues throughout the remainder of the program.

ORIENTATION 28.5 HOURS*

Although this is not a formal module, it serves as a means of systematically introducing students to the core curriculum. The orientation activities are designed to give the students an understanding of the objectives and activities of the Project EFFECT curriculum and a sense of how they fit into the overall program as well as to become acquainted with students and assess their basic skills and knowledge of energy issues. Students are introduced to Project staff and to each other and begin Group Dynamics activities designed to help them work in teams. Policies and Procedures are carefully explained and the group is familiarized with Indiana University services and facilities.

PRE-REQUISITES: N.A.

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: 8th grade

Dexterity: N.A.

Spatial Orientation: N.A.

*Not included in total hours of instruction

ORIENTATION

OBJECTIVES

1) Understand the objectives of PE - both its broad goals and how it affects the trainees in terms of curriculum and training.

2) Become acquainted with Project staff and key university personnel and know what can be expected of each of them.

3) Become acquainted with fellow students and begin to learn techniques for working in groups.

4) Understand Project policies and procedures; i.e., attendance, grade requirements.

5) Become familiar with IUSB facilities and student services and resources.

RESOURCES

1) Group Dynamics Consultant
2) Study Skills and Time Management Instructor

ORIENTATION SYLLABUS

Session#	Hours	Objectives	Topic
1	3	1, 2	Introduction of staff - welcoming of students Mosel - group introduction
2	1.5	4	Policies and procedures
3	1.5	1, 3, 4	Reception
4	1	5	Library tour
5	1	1	Pre-test - Energy
6	2	3	Introduction to group dynamics; introduce one another, talk about personal expectations of the project
7	3	5	Review of note taking methods, fundamentals of studying and class preparation
8	3	5	Time Management Skills
9	3	NA	Test of Adult Basic Education (TABE) - Goodwill
10	2	1	Orientation Evaluation
11	1.5	1, 2, 3	Group work in study patterns, personal goals and plans of action
12	6	NA	Differential Aptitude Test (DAT) - diagnostic exam

MATHEMATICS REVIEW 17 HOURS

Since most of the technical modules involve algebra computation, a unit reviewing basic algebraic concepts and functions is introduced early in the training program. This module includes positive and negative numbers; addition, subtraction, multiplication and division of variables and constants; percentages; scientific notation and rules for "rounding off" numbers. Equations are introduced and students are asked to solve for one or two variables. Math related modules are appoached and taught with the students' background and confidence level fully in mind. Performance is monitored in an individualized manner, recognizing the varied strengths and weaknesses of the students. This module is critical to the "pace setting" of the training.

PRE-REQUISITES: N.A.

COGNITIVE SKILLS:

Reading and writing level: N.A.

Math level: Basic math

Dexterity: N.A.

Spatial Orientation: N.A.

MATHEMATICS REVIEW

OBJECTIVES

1) Work energy calculations in appropriate English and metric units

2) Work addition, subtraction, multiplication and division of variables and constants

3) Work with exponents and square roots

4) Solve for one or two variables in an equation

5) Use scientific notation

6) Perform operations with vulgar and decimal fractions and reciprocals

7) Calculate percentages

8) Recognize significant digits and know rules for "rounding off" numbers from calculations in various applications

RESOURCES

HANDOUTS

1) Handout #1 "The Flow of Energy in the U.S. System"

MATHEMATICS REVIEW SYLLABUS

Session #	Hours	Objectives	Topic
1	1.5		Diagnostic test
2	1.5	2	Operations in arithmetic and scientific notation
3	1.5	1,3,5,6,7	Exponents, scientific notation, English and metric units, percents (Example: U.S. energy use and growth rates
4	1	1,8	Units of measurement, exact vs. approximate numbers, rounding off, significant digits
5	1	6,8	Reciprocals, fractions, rounding off (Example: Heat loss formula)
6	1.5	2,7	Percentages (problem sheet), algebra: operations with variables
7	1.5	2,4	Algebra: expressions and linear equations
8	1.5	2,4	Algebra: Equations, orders of operations, and roots
9	1.5	3,4	Pythagorean theorem, square roots (Examole: Figuring pitch and length of roofs.
10	1.5	3,4	Quadratic equations: factoring and completing the "square"
11	1.5	1-8	Review for exam -
12	1.5		Exam (post-test)

PROJECT EFFECT

(IUSB)

Basic Mathematics

Diagnostic Test-Pre Test

STUDENT'S NAME (Please Print)_____

A. ADD:

1.	2.	3.	4.
0.5	0.97	35.47	7.630
0.2	0.12	52.69	5.764
0.1	0.04	47.83	7.658

SUBTRACT:

5.	6.	7.	8.
0.7863	82.695	0.49643	17.8
0.3854	38.486	0.15628	4.6

Round each of the following to nearest tenths:

9. 8.64 = 10. 28.65 = 11. 5342.873 =

Multiply and reduce the answer to lowest terms:

12. 2/3 x 3/5 = 13. 5/8 x 16/45 = 14. 2/5 x 5/16 =

Divide and reduce the answer to lowest terms:

15. 1/3 ÷ 2/3 = 16. 4/5 ÷ 8/15 = 17. 5/8 ÷ 10 =

18. 15/22 ÷3/2 = 19. 4/9 ÷ 16/81 = 20. 3/4 ÷ 27/86 =

B. Find the value of the following when a=1, b=2, c=3, d=4:

1. ab = 2. a^2c = 3. 18abc = 4. 5a + b =

5. 8b + 3c - 4d = 6. d - b - a = 7. $\frac{d - b}{2}$ =

8. $\frac{3b + 4d}{11}$ = 9. $(c - a)^2$ = 10. $d^4 - d^4$ =

PROJECT EFFECT
BASIC MATHEMATICS
FINAL EXAM - DIAGNOSTIC POST TEST

A. 1. For each of the following statements, write the equivalent algebraic expression:

(a) The number which is 6 more than 3 times x

(b) Total cost of y barrels of oil per day at $14.50 per barrel

(c) The time required to travel 250 miles at a speed of x miles per hour

(d) The number which is 4 more than 3 times y

(e) The sum of 3a, - 4a and 3b

2. Simplify the following:

(a) $6a + 8a - 12a$

(b) $(16a^2 - 3b^2) + (-4a^2 + 3b^2) - (6a^2 - 5b^2)$

(c) $(2x + 5y - 4)\ 3x$

(d) $\frac{5x}{18} + \frac{4x}{9}$

(e) $\frac{x + y}{y} + \frac{x + y}{x}$

B. 1. Write the following products in scientific notation:

(a) 432×10^2

(b) 3400×10^3

(c) 0.0034×10^6

(d) 0.001×10^9

2. The U.S. daily oil imports (including Iranian oil) was 8.65×10^6 barrels. Of this total, Iranian oil comprised about 5%

(a) Express U.S. import of Iranian oil in number of barrels per day.

(b) If the U.S. has to make up for the loss in Iranian oil as a result of the political disturbances in Iran, by importing from other sources, how many barrels per day will be needed to keep U.S. daily imports of 8.65×10^6 barrels/day unchanged?

(c) Assuming U.S. daily imports remain at 8.65×10^6 barrels/day, but the cost goes from $12.70/barrel to $19.15/barrel, how much more will oil imports cost the U.S.? (answer in millions $/day)

(d) Give the answer for (c) in % increase

(e) If a barrel of oil weighs 306 pounds, what fraction of a ton will 200 barrels represent? (write your answer in scientific notation)

C. (a) Solve the following equations:

1. $9x = 4x + 20$
2. $x/3 + x = 16$
3. $x + 7 = 6x + 4 - x$
4. $10y + 7 = 43$
5. $\frac{3x}{2} + 1 = 7$

(b) Slove the following quadratic equations:

1. $(x - 1)^2 = 4$
2. $(x + 3)^2 = 9$
3. $x^2 - 4^2 = 0$
4. $x^2 - 6^2 = 0$
5. $(x - 5)^2 = 3$
6. $x^2 - 9x + 2 = 0$
7. $x^2 + 5x + 3 = 0$
8. $x^2 - 11x - 26 = 0$
9. $x^2 - 8x - 20 = 0$
10. $x^2 + 10x + 25 = 0$

D. Perform the indicated operations, and give your answer to three (3) significant digits

1. ADD:

(a)	(b)	(c)	(d)	(e)
2.55	1.97	35.47	7.630	19.510
10.06	4.12	52.69	5.764	2.570
5.58	11.04	47.83	7.658	1.001

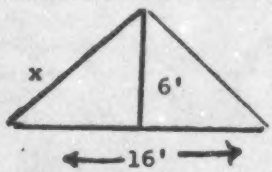
2. SUBTRACT:

(a)	(b)	(c)	(d)	(e)
2.7863	82.695	3.49643	17.899	201.5
1.3854	38.486	2.15628	15.389	5.6

E. 1. Find the value of the following when a=1, b= -2, c=3, d= -4

(a) ab
(b) a^2b
(c) $18abc$
(d) $5a + b$
(e) $\frac{d - b}{2}$
(f) $(b-d)^2$

2. The rise of a rafter is given as 6 feet and the ceiling joist, span is 16 feet. Using the Pythagorean Theorem ($c^2 = a^2 + b^2$) calculate the line length of the rafter.



x = line length

BASIC WRITING 9.5 HOURS

Observing carefully and reporting accurately are two important tools of the Energy Extension Agent. This module is designed as a review of basic writing skills in an attempt to build profiency in concise, accurate expository report writing. Students are taught to revise and edit their own work in an objective manner. Those with special writing problems receive individual attention on an ongoing basis.

PRE-REQUISITES: N.A.

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: N.A.

Dexterity: N.A.

Spatial Orientation: N.A.

BASIC WRITING

OBJECTIVES

1) Use basic rules of grammar (i.e., sentence structure, subject and verb agreement, spelling and punctuation) in writing.

2) Write paragraphs demonstrating understanding of essentials of paragraph construction.

3) Careful observation and precise, accurate and objective writing.

4) Use editing skills on own and others' work.

RESOURCES

HANDOUTS

1. Handout #1, "Planning Worksheet - Basic Writing"
2. Handout #2, "Report Writing"
3. Handout #3, "Project Effect, IUSB, Basic Writing - Foreign Affairs"
4. Handout #4, "Technical and Business Writing - Report Writing"
5. Handout #5, "Writing Problems"
6. Handout #6, "Coordinating Conjunctions"
7. Handout #7, "What is Description?"
8. Handout #8, "Description of a Process"

BOOKS AND REFERENCES

1. The Little English Handbook, E.J. Corbett, J. Wiley & Sons, Inc., 1973, 1977
2. Foreign Affairs, "Energy Strategy: The Road Not Taken?", Amory Lovins, v. 55 no. 1, October 1976
3. Symposium - Energy Sources for the Future, Sanders, John, Oak Ridge, TN, July 5-23, 1976

BASIC WRITING SYLLABUS

Session #	Hours	Objectives	Topic
1	1.5	1, 4	Introduction to basic grammar - write an argumentative paper - exchange papers and edit each others - tie in with energy survey Term Search: Lay and technical definitions of energy terms.
2	1.5	1	Grammar continued - Planning Worksheet, Handout #1 "How to set up a Paper" - write paper on the cultural life of South Bend as a team effort - discuss components of technical writing - read Sanders' article; What makes this technical? - Handout #2, "3 Main Sections of a Basic Definition."
3	1.5	3, 4	Hand in definitions and discuss: Four Basic Types of Writing, Steps of Writing a Paper: Abstract, Summary, Thesis Statement.
4	1	2	Handout #3, "Lovins' article" - Discuss components thesis statement - compare with Sanders - Handout #4, "Technical Paragraphs" - select two different comparison patterns from handout and write topic sentence for each.
5	1	1, 3 & 4	Go through three pages of Handout #5, "Writing Problems" - hand in comparison paragraphs - grammar continued, Handout #6 "Understanding Adverbs and Coordinating Conjunctions".
6	1	1, 3	Go over paper; Handout #7, "What is a Description?" Look at "Spaghetti Chart" - outline how to describe it.
7	1	2, 3 & 4	Discuss descriptive paragraphs - describe furnace - in-class writing exercise.
8	1	3	Handout #8, "Description of a Process" - Process description - hand back furnace paper - write set of instructions on insulating attic.

ENERGY OVERVIEW 68.5 HOURS

This introductory unit gives the students basic tools with which to understand and work with most of the other information subsequently given during the training course. It supplies the basic vocabulary necessary to discuss the energy situation and gives an overview of the issues being raised in the nation and the world regarding energy resources, utilization, and conservation. Through the use of the Energy-Environment Simulator, students are shown in a most graphic way the consequences of several alternate energy policies and the implications for the future of espousing any one policy to the exclusion of others.

This module is the springboard to the entire training program. The combination of classroom and field experiences gives students a sense of the total picture and prepares them for the curriculum which follows.

PRE-REQUISITES: Orientation

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: Ability to understnad simple graphs and tables

Dexterity: N.A.

Spatial Orientation: Ability to read simple maps and schematic drawings

ENERGY OVERVIEW

OBJECTIVES

1) Define and use energy vocabulary in simple discussions of the topic.

2) Understand and describe the operations of some of the major energy suppliers in Michiana.

3) Discuss the principle sources and uses of energy in the United States and the rest of the world.

4) Demonstrate a functional understanding of basic social, political and economic concepts in energy production and use.

5) Demonstrate a functional understanding of present and future energy technology.

ENERGY OVERVIEW

RESOURCES

HANDOUTS

1. Energy Transformation - class exercise.
2. Sanders, John, "Energy Sources of the Future:, proceedings from Symposium - Energy Sources for the Future, Oak Ridge, TN, July 5-23, 1976.
3. F. S. Patton - "Energy: Social and Political Aspects", proceedings, as above.
4. Lovins, Amory, "Energy Strategy: The Road Not Taken?" Foreign Affairs, v. 55 no. 1 October 1976.
5. Weinberg, Alvin, "Reflections on the Energy Wars", American Scientist v. 66, March - April 1978.
6. Hayes, Earl T. "Energy Resources Available to the U.S., 1985-2000", Science Magazine 19 January 1979, v. 203 no. 4377.
7. Friend, Gil and Morris, David, Kilowatt Counter: A Consumers Guide to Energy Concepts, Quantities, and Uses, published by Alternative Sources of Energy Magazine, 1975. Institute for Local Self-Reliance - Figure 4 The Flow of Energy in the U.S. System in 1970 (spaghetti chart).

BOOKS AND REFERENCES

Hubbert, M. K., "Survey of World Energy Resources" Symposium proceedings Energy Sources for the Future, July 7-25, 1975, Oak Ridge, TN

Commoner, Barry, Poverty of Power, New York, N.Y., Knopf, Inc., 1976

Ruedisilli, L. C., and Firebaugh, M. W., ed., Perspectives on Energy 2nd edition, New York, Oxford University Press, 1978

Healy, Timothy J., Energy and Society, Boyd and Fraser, Publishing Co., San Francisco, CA 1978

DOE INFORMATION: Weekly Announcements, Washington, D.C. Office of Public Affairs, 1977-78

DOE FACT SHEETS, #12, 13, 14 National Science Teachers Association

QUIZ #1
Exam Part I
Exam Part II

ENERGY OVERVIEW SYLLABUS

Session #	Hours	Objectives	Topic
1	4	1	Term search: assignment and worktime - teams of 3 (look up definitions of terms necessary for discussion of energy issues and technical problems). Oral reports to class on meaning of terms.
2	2	2 & 5	Concepts of Thermodynamics - in-class assignment and activity: "Energy Transformation" - Tracing energy flow: addressing practical description of theoretical concept; example: how coal becomes electricity.
3	3	3, 4, & 5	Energy Use and Growth Patterns in the United States - Preparation for Energy-Environment Simulator exercise (history of changes in energy use per capita from caveman - to - today) plus future projection.
4	2	3, 4 & 5	Energy Environment Simulator - Class participation exercise.
5	3	3	Integration of math and energy overview - discussion of system of energy flow in U.S. 1970 (spaghetti chart) - Discuss efficiencies of different sectors of U.S.
6	2	3, 4 & 5	"Energy Options Fishbowl" I - discussion of Lovins and Weinberg articles as pre-test - to examine current, uniformed opinions and perceptions of the "energy crisis."
7	1.5		Quiz: Demand-energy supply options based on Lovins and Weinberg; spaghetti chart and math work.
8	3	2 & 5	Field trip - Twin Branch Power Plant - oil-fired steam electrical generating plant. Preparation and discussion. Observation of plant.

ENERGY OVERVIEW SYLLABUS

Session #	Hours	Objectives	Topic
9	2		Discuss Quiz #1 - work through problems.
10	3	3 & 5	Fossil Fuels - Introduction World energy flow sheet Oil and coal production Fuel mix in U.S. and how it has changed over time. Development of a finite natural resource. (M. K. Hubbert's Bell Curve Theory).
11	2	3 & 5	Oil: History, Functions, Manufacturing, Searching for Oil and Natural Gas, Marketing, Drilling Facts, Oil Well Life
12	6		Cook Nuclear Power Plant - Field Trip
13	1.5	3 & 5	Oil Production - Charting production in '78 - (bring up to date) - Imports, reserves - Coal - Supply and Production.
14	3	3 & 5	Nuclear Energy Conventional Nuclear Power Technology Reactor, fission - Terms: Fissile, fertile chain reaction (critical system); controls, design approach.
15	2	3 & 5	Nuclear - continued
16	1.5	3 & 5	Assigned Oral Reports - Assist students with topic choice and research sources.
17	3	2	Preparation - Oral reports: Alternate energy.
18	2	2	Oral reports: Alternate energy.

ENERGY OVERVIEW SYLLABUS

Session #	Hours	Objectives	Topic
19	1.5	2	Oral reports
20	3	2	Wrap-up oral reports. (At this point the Solar Module is introduced. See technical modules.)
21	2	1,3,5	Energy Options Fishbowl Debate II; Preparation time - in two teams (hard vs. soft path)
22	6	2	Field trip: Michigan City Power Plant - Cooling Tower: How it works. Power plant
23	1.5	1,3,5	Preparation time for Energy Options Fish-bowl Debate II
24	3	1,3,5	Preparation time for Energy Options Debate II
25	2	1,3,5	Energy Options Debate II - Two teams debate "hard" vs. "soft" path in energy manage-ment - 1900-2000
26	2		Final exam
27	1		Review of final exam

ENERGY OVERVIEW EXAM #1
Demand-Energy Supply Options
1/8/79 Open Book and Notes
(1.5 hr.)

1. (14 pts.) Total U.S. energy consumption in 1975 was 71 Quads (10^{15}Btu's). Total population was 213 million. Assuming a 3.6%/yr. growth rate in personal energy use and a 1%/yr. population growth rate:

   a) Find the 1978 population, per capita energy use and total energy use in Quads.

   b) How much of the 1978 total will be used for household and commercial consumption?

   c) How many gallons of petroleum will be needed (both imports and exports) assuming petroleum has a heating value = #2 fuel oil?

   d) Assuming zero population growth, in what year will we be using twice the 1975 total?

   SHOW YOUR WORK!!!

2. (18 pts.) (a) List and briefly explain 3 advantages and three disadvantages of both the Hard and Soft Technology approaches to energy supply.

   (b) List three examples of each (Hard and Soft Technology)

Extra Credit: Another common unit for large amounts of energy is million barrels per day of oil (equivalent) MBDOE. If a barrel of oil is 42 gallons, how many MBDOE is one Quad/yr.?

PROJECT EFFECT

Final Examination - Part I

Energy Overview

1-22

Please show all work, as only partial credit will be given for answers only.

(1) (15 points)
A house designed for passive solar heat collection has a Trombe wall facing south that measures 16 feet by 40 feet by 9 inches thick. At 8 p.m. on a particular day, the temperature of the wall is 80° F. From that time until 10 a.m. the next morning, the outdoor temperature averages 10°F., while the indoor air averages 65°F. If the house loses heat at a rate of 425 Btu/hr/°F., and there is no auxiliary source of heat, what is the temperature of the wall at 10 a.m. the next morning?

(2) A. (10 points)

1. How much heat can a cubic foot of water store over a 25°F. temperature rise?

2. If the Rock$_2$Solar home (240 ft^2 of collector area) collects 1200 Btu/ft^2 on an average sunny day in winter, how much heat does the collector array gather on that day?

3. How many gallons of water are needed to store this amount of heat over a 55°F. temperature rise?

4. How much would this amount of water weigh?

5. How much space would this water occupy?

(2) B. 1. How many cubic feet of rock are needed to store the amount of heat collected in A. 2. above, over a 45°F. temperature rise?

1-23

2. How much would this amount of rocks weigh?

3. How much space would a storage bin twice this size take up?

4. How much heat can a cubic foot of rock store over a 35°F. temperature rise?

5. How much would the amount of concrete in problem #1 weigh?

(3) Total U.S. energy consumption in 1975 was 71 Quads (10^{15} Btu's). Total population was 213 million. Assuming a 3.6%/yr. growth rate in personal energy use and a 1%/yr. population growth rate:

a. (6 points)
Find the 1978 population, per capita energy use and total energy use in Quads.

b. (2 points)
Using 1970 percentages, how much of the 1978 total will be used for household and commercial consumption?

(3) c. (4 points)

Using 1970 percentages, how many gallons of petroleum will be needed (both imports and exports)? (Assuming petroleum has a heating value = #2 fuel oil).

d. (2 points)

Assuming zero population growth, in what year will we be using twice the 1975 total?

SHOW ALL YOUR WORK!!

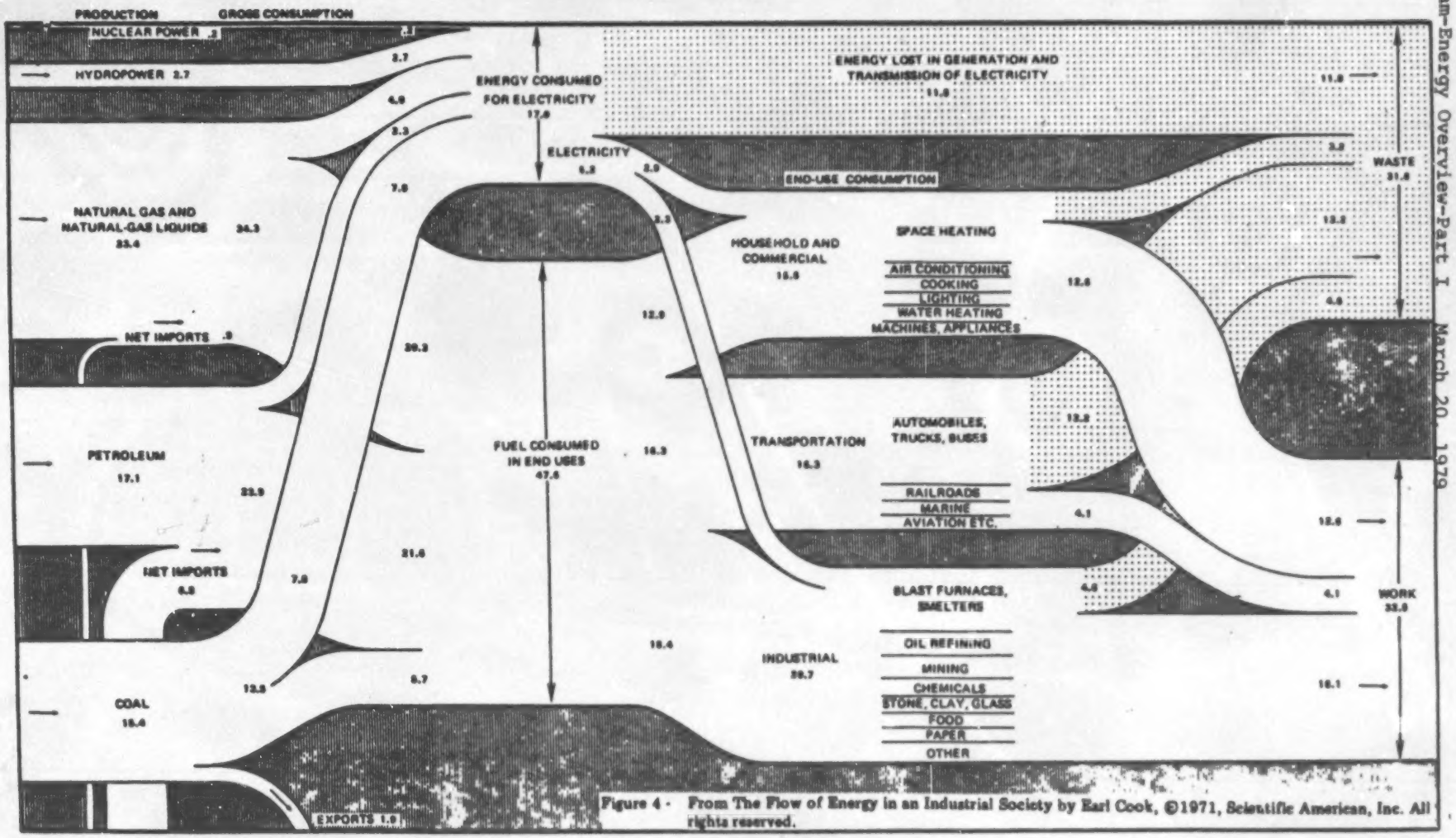


Figure 4 - From The Flow of Energy in an Industrial Society by Earl Cook, ©1971, Scientific American, Inc. All rights reserved.

FLOW OF ENERGY through the U.S. system in 1970 is traced from production of energy commodities (left) to the ultimate conversion of energy into work for various industrial end products and waste heat (right). Total consumption of energy in 1970 was 64.6 x 10^{15} British thermal units. (Adding nonenergy uses of fossil fuels, primarily for petrochemicals, would raise the total to 66.8 x 10^{15} B.t.u.) The overall efficiency of the system was about 51 percent. Some of the fossil-fuel energy is consumed directly and some is converted to generate electricity. The efficiency of electrical generation and transmission is taken to be about 31 percent, based on the ratio of utility electricity purchased in 1970 to the gross energy input for generation in that year. Efficiency of direct fuel use in transportation is taken as 25 percent, of fuel use in other applications as 75 percent.

Fig. 4 The Flow of Energy in the U.S. System

74

75

PROJECT EFFECT

Final Examination - Part II

Energy Overview

1-26

(1) (4 points)
Explain the following formula as it relates to Doubling Time and the Energy Crisis.

$$X = \frac{70}{\% \text{ rate of growth}}$$

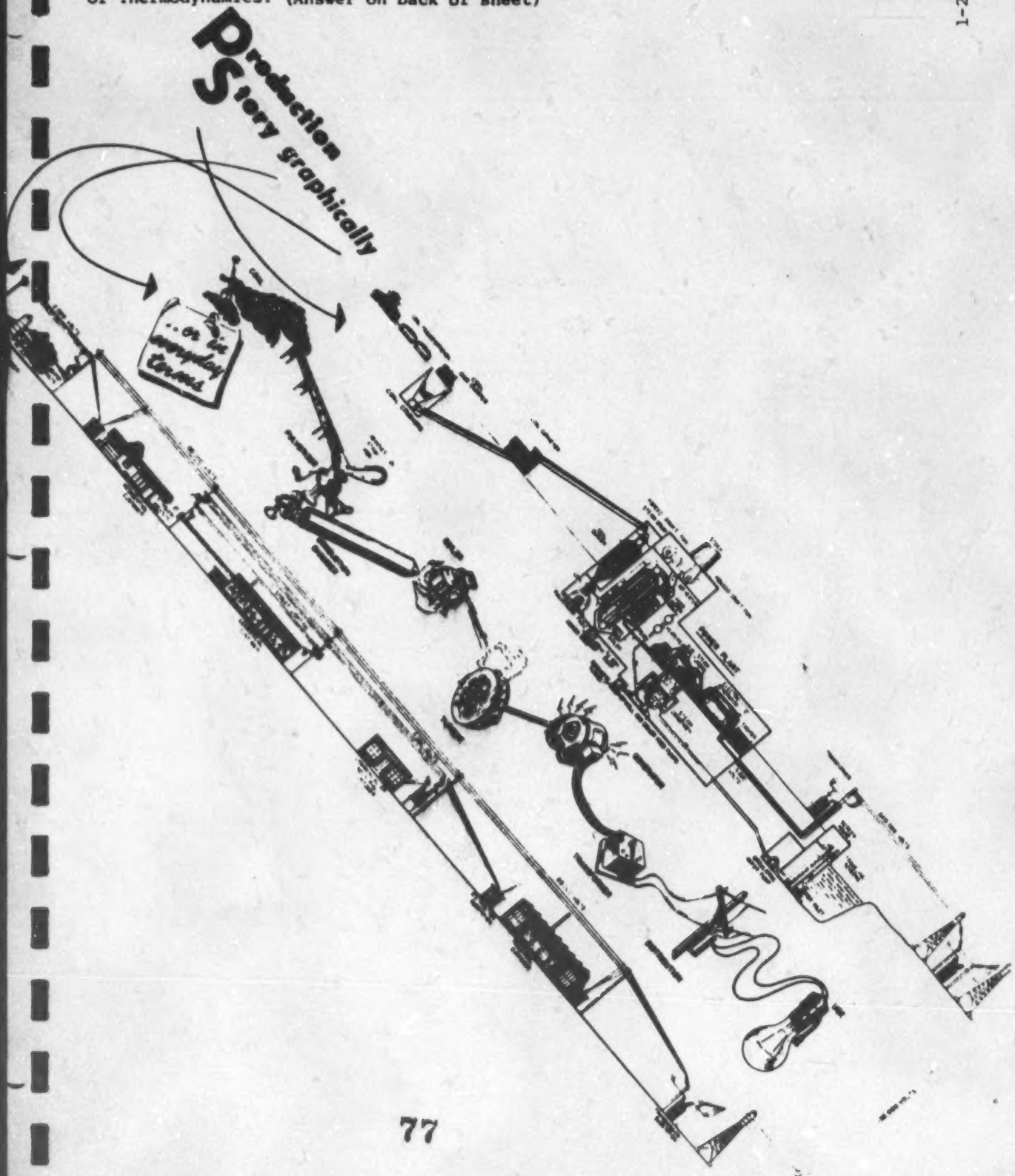
(2) (4 points)
a. Explain Lovin's distinction between "hard path" technology and "soft path" technology.

(9 points)
b. List and give advantages and disadvantages of three examples of "hard path" technology and three examples of "soft path" technology.

(8 points)

(3) In your own words explain the following diagram as it relates to the Second Law of Thermodynamics. (Answer on back of sheet)

1-27



Project EFFECT
Final Exam-Energy Overview-Part II

1-28

(4) a. (2 points)

In your own words state the first law of thermodynamics.

b. (8 points)

How is this law related to the Energy Crisis in the United States?

1-29

(5) (6 points)

a. In your own words explain the following figure:

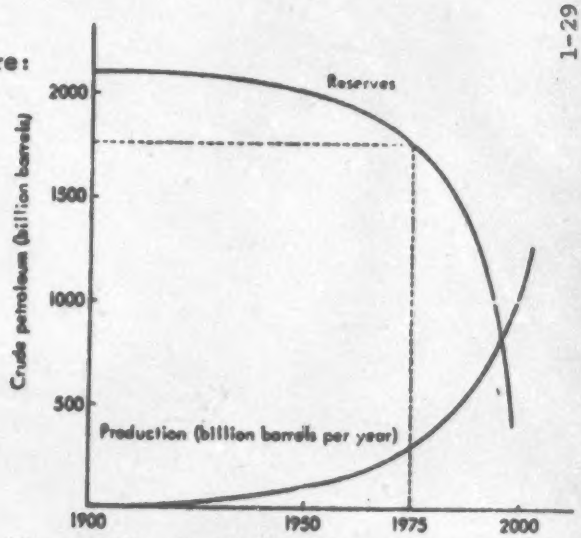


Figure 17-15. *World reserves of crude petroleum will not last long at current consumption rates. Note that in 1975, with no more than fifteen years left before demand exceeds supply, the total global reserve will have been depleted by only 12½ per cent.*

(2 points) In light of your interpretation of Figure 17-15 above,

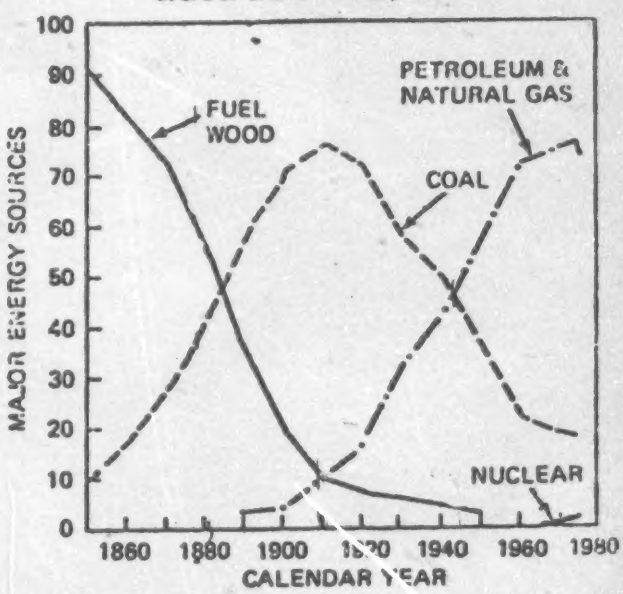
b. Why are the next <u>twenty years</u> so critical to the world energy picture?

1-30

) a. (8 points)

In your own words explain the following figure:

SOURCE: HISTORICAL STATISTICS OF THE UNITED STATES BUREAU OF THE CENSUS; U. S. BUREAU OF MINES, 1974



b. (1 point)
What percent did fuel wood provide in 1880?

c. (1 point)
What percent did nuclear power provide in 1955?

(7) (8 points)

List and briefly explain four potential environmental effects of nuclear power generation.